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ABSTRACT

This paper discusses the development of instruments to measure individual differences in behavior during infancy. The Infant Temperament Questionnaire (ITQ), which was designed to measure the temperament dimensions identified by the New York Longitudinal Study (NYLS), constituted the methodological starting point in the search for a dimensional description of infant temperament. The Baby Behavior Questionnaire (BBQ) was constructed and administered to 791 infants between 3 and 10 months of age. The Toddler Behavior Questionnaire (TBQ) was constructed and administered to 357 infants between 11 and 15 months of age. Identified factors were required to exhibit unidimensionality, that is, relationship to a unifying element; generality across several situations; and stability across samples. Seven factors identified in both instruments included intensity and activity, regularity, approach-withdrawal, sensory sensitivity, attentiveness, manageability, and sensitivity to new food. In addition, an adaptability factor was identified for the TBQ. These factors were not close replicates of NYLS dimensions. Although previous research suggested that a manageability factor would be representative of infant irritability, the identified manageability factor was unexpectedly constituted of a broad conglomerate of diverse behaviors. A list of 19 references is included. (BC)

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The Search for Meaning in Factor Analytically Derived Dimensions

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The main aim of this paper is to present work done for establishing a meaningful structure encompassing the behavioral diversity seen in young infants. I will try to highlight issues of conceptualization which often occur in work with dimensional structures, established with strict statistical treatment of data. In this context I will also relate some of our work done to gain a deeper understanding of dimensions brought forth by the multivariate techniques used.

NYLS dimensions and the dimensionality of the ITQ

The practical aim of our work, which was begun in the mid 70's, was of course to establish an instrument for description of individual differences in behavior during infancy. Theoretical and methodological inspiration came from the NYLS (e.g. Thomas & Chess, 1977) with their starting point in the phenomenon itself - the variability of the total behavioral repertoire in young children. Temperament was seen as the HOW of behavior, that is, the stylistic aspect of behavior. The nine NYLS dimensions of temperament (see Table 1) had been derived from careful interviewing of parents and visual content analyses of interview protocols concerning the behavior of 22 3-month-old infants.

The advantage of this approach was the exhaustive and relatively unbiased collection of data obtained concerning infant behavior variability. The drawbacks were that the subjective nature of the content analysis employed gave no assurance that behaviors grouped

together constituted separate categories, it did not allow for unique behavior variance to be identified, and that the small sample size left the possibility open for unrepresentativeness in the behavioral data and in the temperament structure.

In our search for a dimensional description of infant temperament, Carey's (1970) Infant Temperament Questionnaire (ITQ), designed to measure the NYLS dimensions, constituted the methodological starting point. We used the ITQ in a pilot study (N=128) of 3-4 month-olds who were rated by their parents.

Although we were well aware of the inadequate sample size for multivariate statistical treatment, we still tried exploratory factor analysis as a first step. This work with the original ITQ resulted in a 9-factor orthogonal principal component structure (see Table 2) as the most meaningful solution to the problem of grouping the 59 items (from the original 70 items, 11 had to be discarded due to low response frequencies; Hagekull, 1989). The conclusions were clear:

1. the ITQ provided a useful starting point for the search for a dimensional structure describing behavioral individuality in young infants, because broad dimensions reflecting behavioral dispositions could be identified.
2. the obtained dimensions were no close replicates of the NYLS's nine dimensions. Only rhythmicity corresponded to an original NYLS dimension (cf. Rapoport et al., 1977; Sanson et al., 1987).

For our further work along these lines we postulated the following criteria for factors to be considered as reflecting temperament (Table 3):

1. unidimensionality - a unifying element for the diverse items clustered in a factor, referring to a possible child disposition, should be identified
2. generality - a factor should reflect behaviors in several situations
3. stability of factors across samples

Dimensionality of infant behavior

On the basis of pilot study results the Baby Behavior Questionnaire (BBQ) was constructed and tried out in a representative sample of 791 3-10 month-old infants (Bohlin, Hagekull, & Lindhagen, 1981). About 70% of the 54 BBQ items originated from the ITQ. To cover the behavioral repertoire of one-year-olds, some BBQ items were altered and some were added to form the Toddler Behavior Questionnaire (TBQ) which was used in a sample of 357 infants, aged 11-15 months. It contained 60 items, 60% of which came from the ITQ (Hagekull, Lindhagen, Bohlin, 1980).

The BBQ sample allowed cross-validation across both two age groups (3-6 months and 6-10 months) and two random samples in each age group. The TBQ sample was also randomly split in two groups. After a number of factor analyses, comparing solutions with different number of factors, solutions with different rotations, and from different ages, we came up with two solutions, one applicable to the whole BBQ age range and and one for the

TBQ ages (Table 4). The chosen crossvalidated solutions showed considerable similarity across ages. Looking closer at the factor contents, the criteria postulated made us exclude the new food factors (situation specific), and the adaptability factor (not stable in cross-validation). The criterion of unidimensionality, that is, that a unifying behavioral disposition should be discernible in the factor, was fulfilled in most factors. Energy level or expenditure is easily inferred from the behaviors in the Intensity/Activity dimensions, and rhythmicity in more biologically regulated behaviors is seen as the disposition behind Regularity. The Approach-Withdrawal dimension which only consisted of behaviors in new social situations could tap the disposition of sociability and/or early shyness. Sensory Sensitivity reflects threshold and reactivity to strong environmental stimulation, and Attentiveness the infant's capacity to detect and react to small environmental changes.

There is, however, one notable exception: the Manageability factor, appearing in the older age groups and increasing its importance as regards explained variance (not found in the youngest group, emerging in the second age group and appearing invariably as factor number 1 or 2 in all solutions from the TBQ sample). This factor contained items reflecting persistence, adaptability, mood, and activity in a large variety of situations (see Table 5) but the unifying element was difficult to see. Although it did not fit in with our previously set criterion of unidimensionality, we were

reluctant to throw it out of the system mainly because of its increasing importance in explaining behavioral variance. So we tentatively named the factor Manageability, because it seemed to have something to do with how easy the child was to handle for the parent in various situations. We remained puzzled and intrigued by this factor and I will return to it later.

To relate our clusters of items to temperament research and constructs, we applied the NYLS criterion of temperament dimensions as reflecting the HOW of behavior (rather than the WHAT or WHY) to the factors we had accepted as descriptive of infant behavioral differences. Could the unifying element in each factor be seen as a stylistic aspect of behavior? This was clearly the case for the Intensity/Activity factors, for the factors describing rhythmicity in biologically based functions, for the Approach-Withdrawal dimensions, describing emotional reactivity to novel persons and situations, and for the factors dealing with sensitivity to sensory stimulation. Also Manageability seemed to describe HOW the infant reacted and behaved in a number of situations. The unifying behavioral element in the Attentiveness factors, on the other hand, was more likely to be alertness or cognitive capacity. Most items described whether a reaction occurred or not rather than the how of responding, and these factors were thus seen as reflecting a broad behavioral, but not a behavioral style, dimension. However, as has been discussed by Mary Rothbart (1989), attentional processes have been included

in several other temperament approaches. A distinction between attention-getting and attention-holding processes could be made. In our dimensional structure, this distinction was reflected in that attention-getting behaviors had clustered in the Attentiveness factors, while behaviors indicative of attention-holding processes were found in the Manageability factors.

To conclude this section of the presentation I would say that with factor analysis applied with fairly strict methodological and conceptual constraints, we had achieved a promising structure in which all factors could be related to temperament theory. The factors were again with the exception of Regularity, no close replicates of the NYLS dimensions; some factors such as Sensory Sensitivity and Approach-Withdrawal were more narrow, others combined items from different scales, such as Intensity/Activity. Finally, the factor analytic work had also resulted in unexpected findings, such as the broad conglomerate of diverse behaviors in the dimension of Manageability. More work was clearly needed to understand this factor. I will exemplify with results from some of the studies we have done and try to show how our understanding has grown as regards the Manageability dimension.

The conceptualization of the Manageability dimension

We had some preliminary ideas about the Manageability factor as being an indirect representation of irritability and possibly also more reflective of the parent-child relationship than the rest of the factors.

Adhering to the general idea of behavioral variability as being partly of constitutional origin (Goldsmith et al.,1987), we started out searching for an early appearing infant characteristic, possibly irritability, as underlying the Manageability dimension. In a study of 37 newborns, assessed with the Brazelton Neonatal Behavioral Assessment, regulation of state in the newborn period predicted manageability at 4 months (r=.35) and orienting and habituation were related to 12-month manageability (r=.38 and r=-.36; Hagekull, 1985). These results fit in nicely with BBQ/TBQ item content at the different ages (see Table 5). In the Manageability factors, activity and adaptability to new routines were important features in the younger sample together with persistence, while persistence and mood items were more prominent at the older ages. Thus, the more self-regulatory ability (and probably the less irritability) the newborn infant had shown, the more content s/he was as a 4 month old baby when left to amuse her/himself and when encountering in new situations. When concentration, persistence, and mood became more important aspects of manageability around one year of age, the neonatal capability of orienting to new stimuli was shown to be of predictive value. Rapid habituation in newborn infants was predictive of negative mood and low persistence, which might be seen as equivalent to rapid habituation, at 12 months. We interpreted this as yielding some indirect support for the idea of a relationship bewteen Managability and early irritability.

The relationship between manageability and irritability was more directly explored in a study of 29 3-7 month-olds. Maternal ratings of manageability were found to be associated with direct observations of frequency of irritability outbursts during a period of 8 days (r=.45; Hagekull, 1989).

The irritability or negative emotionality disposition thus suggested to be a uniting feature for the diverse manageability items also led us to search for the association between manageability and the wellknown temperamental constellation of difficult temperament (Thomas, Chess, & Birch, 1968), which also has connections to negative emotionality. By using the LISREL causal model building programs we found support for a difficult child construct in the oldest age group (11-15 month-olds). Manageability was the most important factor in the second order factor analysis used to study the latent construct of difficultness (Hagekull, 1985).

Because infant irritability would seem to be an important characteristic for the developing parent-child relationship, these findings also strengthened our preliminary ideas about manageability as important in a relationship context. We have received support for this in that manageability has been found to relate to both observed behavior of mothers (and children) and to maternal role satisfaction (Hagekull & Bohlin, 1986; 1990). In preliminary analyses, Manageability has also been found to predict infant attachment behavior with fathers in a modified Strange situation. The prediction

was especially strong for female infants (Hagekull & Bohlin, 1988).

In recent research, using temperament as a predictor variable, infant manageability, based on data aggregated from ages 10, 15, and 20 months, has been shown to predict outgoing conduct problems (aggressive and concentration problem behaviors; r=-.36) studied with the Behar and Stringfield (1974) Preschool Behavior Questionnaire in a sample of about 100 4-year-olds (Hagekull & Bohlin, 1990). This result is in line with recent reports (Bates, Maslin, & Frankel, 1985; Kyrios & Prior, 1990) about predictability from difficult temperament.

The development of the Manageability dimension

Finally a few words about the development of Manageability in terms of another temperament structure. To investigate the connection between infant temperament and early preschool temperament we have used the BBQ and TBQ for the younger ages and the Buss and Plomin (1975) EASI questionnaire measuring Emotionality, Activity, Sociability, and Impulsivity for age ranges above the ones BBQ and TBQ were developed for. This has been done in an ongoing longitudinal study of about 110 children, so far followed from 6 weeks to 4 years of age. At age 20 months, both TBQ and EASI were used, spaced one month apart. An exploratory factor analysis on maternal data, factoring items from both questionnaires yielded an interesting structure where the manageability persistence items clustered together with impulsivity items in one

factor and the TBQ mood items formed a factor of its own. This structure was replicated using paternal data. Predictions from infant manageability (aggregated mother and father data from 10, 15, and 20 months) to the EASI dimensions at two age periods, 28-36 months and 43-48 months (aggregated mother and father data), showed Manageability to be the main predictor of Impulsivity and Emotionality at both age periods. In regression analyses, Manageability also gave independent significant negative contributions to the prediction of Activity and to Sociability when the shyness aspect was taken out (see Table 6).

To sum up our work with Manageability, this dimension is now conceptualized as originating in a negative emotionality or irritability dimension seen early in life, and it develops into impulsivity and negative emotionality in the early preschool period. It is probably of significance for the developing parent-child relationship and for the development of preshoolers' outgoing problem behaviors. So far, it has been the most "productive" dimension in our set of factors in terms of yielding interesting results in correlational studies.

So I will conclude this presentation by emphasizing the importance of a sound psychometric and conceptual base for further work in temperament. At the same time as I stress the importance of strict criteria, I will also point to the necessity of not adhering too strictly to them. Adhering to such a strategy, we now think we have a

dimensional structure of temperament in infancy which is a useful and conceptually fairly clear system for discribing the large variability of infant behavior.

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Table 1.

The NYLS Nine Dimensions of Temperament

Activity Level

Rhythmicity (Regularity)

Approach or Withdrawal

Adaptability

Intensity of Reaction

Threshold of Responsiveness

Quality of Mood

Distractibility

Attention Span and Persistence

Table 2

Pilot Study Factors from the ITQ

reactivity to wet or soiled diapers

intensity/activity

rhythmicity

reactivity to food variation

threshold and persistence

mood

adaptability/approach

feeding behaviors

mood, adaptability, approach

Table 3.

Criteria for Temperament Dimensions

1. unidimensionality - a unifying element for the diverse items clustered in a factor, referring to a possible child disposition, should be identified
2. generality - a factor should reflect behaviors in several situations
3. stability across samples

Table 4.

Interpreted Factor Solutions From the BBQ and the TBQ

Factor no.	BBQ sample 3-10 mo. n=791	TBQ sample 11-15 mo. n=357
1.	Intensity/Activity	Intensity/Activity
2.	Regularity	Manageability
3.	Approach-Withdrawal	Regularity
4.	Sensory Sensitivity	Approach-Withdrawal
5.	Attentiveness	Sensory Sensitivity
6.	Manageability	Sensitivity to New Food
7.	Sensitivity to New Food	Attentiveness
8.	--	Adaptability

Table 5.

Items in the Manageability Dimensions

BBQ (3 - 10 mo.)	TBQ (11 - 15 mo.)
Persistence in self-amusement	Persistence in self-amusement
Persistence in toy play	Persistence in toy play
	Persistence watching TV/ "reading" books
	Persistence in social play
	Concentration during feed
Mood during diaper change	Mood during diaper change
	Mood when face is wiped
	Mood being dressed
	Mood when having nails cut
	Mood after feed
Activity during diaper change	Act. during diaper change
Activity during bath	
Adaptability of sleep habits in new places	
Adaptability in new situations/places	

Table 6.

Manageability and Irritability

Age	Variables		Age	Correlation
newborns	Reg. of state	- Man.	4 mo	.35
newborns	Orienting	- Man.	12 mo	.38
newborns	Habituation	- Man.	12 mo	-.36
3-7 mo	Freq. of irr.	- Man.		.45
Difficult child construct		- Manageability		-.59
		- Intensity/Activity		-.40
11-15 mo		- Regularity		-.32
		- Approach-Withdrawal		-.15

Manageability in Relationship Contexts

15 mo	Man. - Mother neg. behavior			-.51
	Man. - Child neg. behavior			-.32
	Man. - Child pos. behavior			.39
3.5 mo	Man. - Maternal role satisfaction		4 mo	.30
	Man. - " irritability		4 mo	-.40
	Man. - " stress		4 mo	-.26
	Man. - " coping		4 mo	.34
	Man. - " role satisfaction		10 mo	.30
10 mo	Man. - Cry		12 mo	-.29
	Man. - Proximity seeking		12 mo	-.40
	Man. - Avoidance		12 mo	.51
10,15,20 mo	Man. - Outgoing conduct behavior problems		4 yrs	-.36

Table 7.

Predictions From Infant Manageability (Aggregated Mother and Father Data From Ages 10, 15, and 20 Months) to EASI Dimensions at Two Age Periods (N=110 and 105)

	28-36 mo.	43-48 mo.
Emotionality	-.33***	-.33***
Activity		-.18*
Sociability		-.25**
Impulsivity	-.50***	-.42***

Figure 1.

Dimensional Development of Manageability

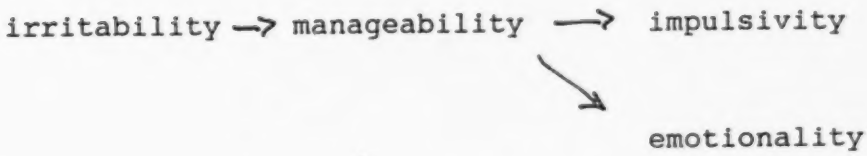

Figure 2

Concurrent and Predictive Relationships